PRELIMINARY OVERVIEW

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I am Bruce Steinetz from the NASA Lewis Research Center. I'd like to extend my welcome to our fifth NASA Seals Workshop. We're looking forward to a very exciting, intriguing couple of days. We've set up a couple of objectives for the workshop and hopefully we will cover your needs as we go about the program. We've invited a number of guest speakers to review the goals and the challenges of both military and commercial endeavors the government is sponsoring including the High Speed Civil Transport (HSR) program, the Advanced Subsonic Technology (AST) program, and the Integrated High Performance Turbine Engine Technology (IHPTET) program. We hope to provide a stimulating working forum - a little less formal than perhaps a normal AIAA conference - where we can share ideas and encourage dialog of a much more open fashion. We want to have wide participation by the industries, university, and NASA, as far as practical and move to an integrated products development team approach for solving the seal problems. We will be publishing a proceeding based on what we have done today and tomorrow as a basis for where we are going in the future. In the next couple of slides I'd like to give you a "thumb-nail sketch" of the morning and afternoon sessions we have planned. As I mentioned, George Bobula, who is standing in for Bob Bill, will present small engine technology work that the Army is doing. John Rhode will give a review of the whole AST program and identify some critical needs there. Joe Shaw will present the work going on in the High Speed Civil Transport program aimed at developing an economically viable supersonic transport for 2010. Ellen Mayhew, who many of you are familiar with, will be presenting seal development efforts under the IHPTET program sponsored by the Air Force.

We will then shift gears a little bit and talk about the aero-derivative market. Ray Chupp will discuss application of aero-derived brush seal technology to ground-base turbine combined-cycle engines. The marine-systems community will present exciting applications of turbine engine to marine drive systems.

Next we will hear of special seal needs for space applications. NASA is now striving for synergy between space and aero technologies to exploit aero-developments wherever possible and apply them to space applications.

Sherry Soditus will provide an overview of engine overhaul and maintenance and provide several case studies. This afternoon, John Munson will discuss Allison's "clean sheet" approach for turbine secondary air flows management. John will demonstrate how applying just a few advanced seal concepts will pay huge performance dividends and result in direct operating cost savings. Next there will be several presentations on recent developments in specific seals including the large diameter aspirating seal, brush seals and honeycomb seals amongst others. The afternoon sessions will present material

developments and also some work on engine case cooling. This evening we are going to have a social and also a dinner for continued discussions.

Thursday morning we will turn our attention to some advances in analytical techniques that are being developed to predict the interaction of the secondary airflow and the power stream flow. Some time ago there was not a significant analytical treatment applied to this area. Now as our machines become very sophisticated, better management of secondary air flows offer significant potential for increased efficiency.

We will also hear some other work, advancing techniques for life predictions, life management; and also a presentation on probabilistic methods. We're challenging ourselves to look at design both from a deterministic approach and a probabilistic approach. Thursday afternoon we will be hearing from George Madzar on smart sensors that monitor sensor health to prevent unwarranted engine shutdowns. Al Kasack and Gerald Brown will discuss Lewis' magnetic bearing program. Bob Mullen from Case Western Reserve University will present design and analysis techniques of micro-machines being built on micro electronic circuits. Finally, we'll wrap up with some discussion on journal bearing stability.

Tomorrow afternoon we're going to be conducting a tour of three facilities: our brush seals rig, our high temp rope seals rig and our magnetic bearing facility.

As many of you know, I manage the seal sub element for the advanced subsonic technology program. The AST Engine Seal locations chart serves as a road map of the different types of seals that we are developing and also as an index of presentations that are going to appear today. AST has embraced the idea of developing advanced seal technology. A number of studies have shown that just by implementing several seals throughout the engine core can achieve 2 to 3 percent reductions in specific fuel consumption (SFC), which goes a long way toward meeting the SFC goal for the AST program. In the AST program, we are specifically looking at advanced film riding type seals for reducing compressor discharge leakage and also for the aft area of the compressor sump. We are looking at techniques to manage the delivery of the secondary air flow from the rim seal area to the main air passage way to minimize losses and increase cycle efficiency. We're looking at clever ways of reducing inter-stage seal leakage. We're looking at techniques for desensitizing turbine tip leakage so they remove the penalty that we pay as we abrade the tip seals away. And finally, we are looking at very large diameter aspirating and brush type seals for controlling the amount of leakage in the large (3 foot diameter) balance piston locations. GE has estimated that replacing 3 labyrinth balance piston seals with aspirating seals can save upward of 1.5% in SFC - a clear motivation for advancing seal technology.

Seal Workshop Objectives

- **Review goals of both NASA and military advanced development programs identifying critical needs.**
- **Provide a working forum for industry, NASA and universities to discuss seal requirements and solutions.**
- **Publish workshop proceedings to capture current state-of-art as basis to build upon.**
- **Establish/maintain close working relations across organizational boundaries to facilitate "Team USA" (e.g. a rather large I.P.D.T.)**

NASA Lewis Seals/Secondary Air Flow Workshop

Wednesday Oct. 23: ***Agenda At A Glance***

- **Welcome:** **Marty Kress:NASA Lewis Deputy Director**
- **Introduction:** **Bruce Steinetz**
- **Overview and Program Needs** **Morning**
  - **Small Engine Technology**
  - **Commercial Subsonic/Supersonic Engine Technology**
  - **Military Engine Technology**
  - **Aero-derivatives**
  - **Perceived Needs for: Space; Hypersonics**
  - **Overhaul/Maintenance**
- **Recent Seals/Secondary Air Management Developments** **Afternoon**
  - **Secondary Air System Study**
  - **Presentations on Specific Seal Developments:**

    Large Diameter; Brush; Rim; Face; Honeycomb; Damper; Tip; Static Seals
  - **Material Developments**
  - **Related Topics**
  - **Engine Case Cooling/Secondary Air Flows**
- **Social** **6:00-8:00**

NASA Lewis Seals/Secondary Air Flow Workshop

Thursday Oct. 24: ***Agenda At A Glance***

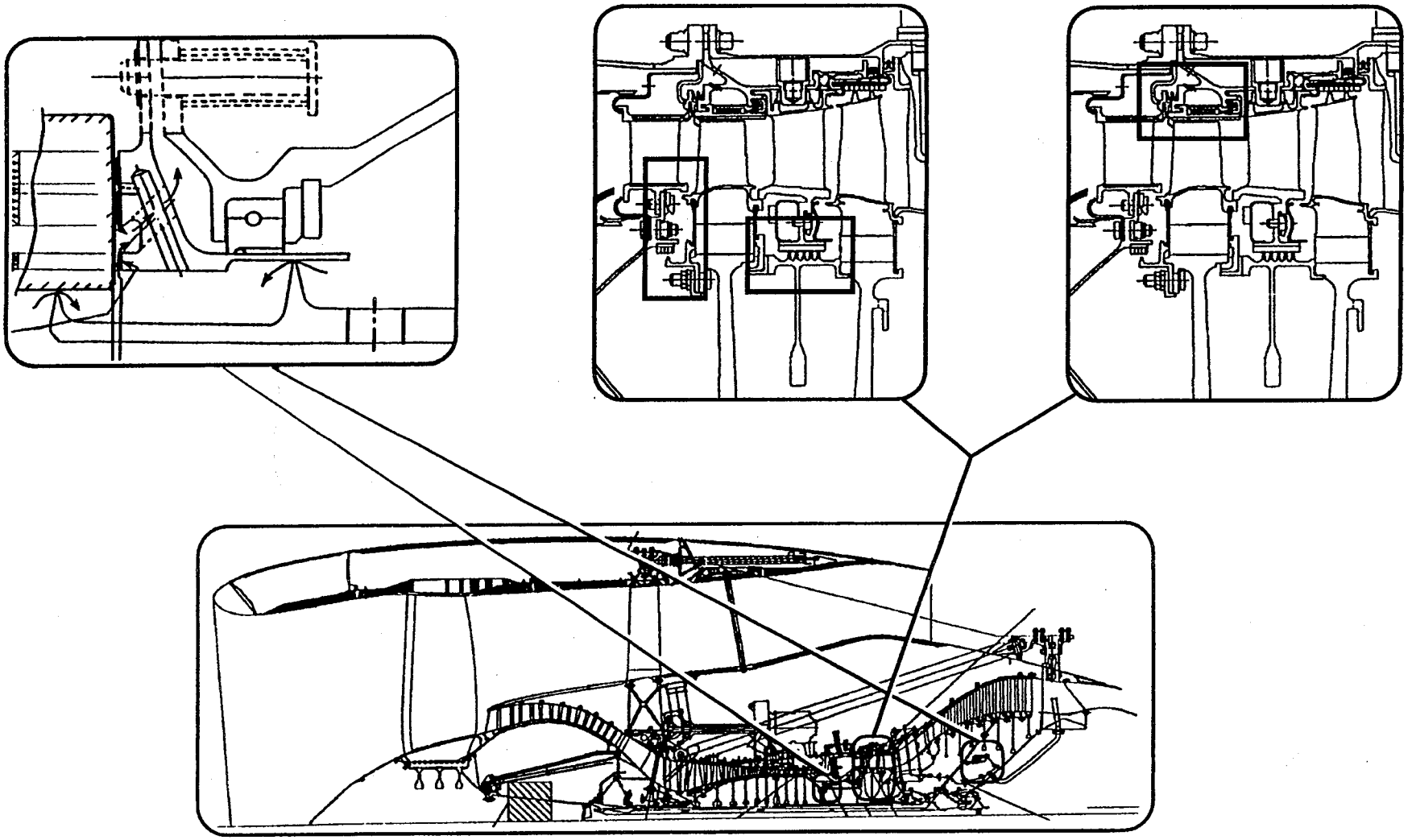
- **Interactive Power Stream/Secondary Stream/Seal Flow Studies** — **Morning**
  - **Time Averaged/Time Unsteady Analysis**
  - **Compressor Inner Band/Rim Seal Ingestion Experiments**
  - **Simulation of Ingestion Mechanisms**
  - **Code Development/Validation**
  - **Life Management/Probabilistic Analysis**
  - **Innovative Sealing Approaches: Gas Bearing/Seal & SMA Seal**
- **Monitoring/Control** — **Afternoon**
  - **Seal Monitoring**
  - **Health Monitoring**
  - **Magnetic Bearings**
  - **Modelling/Design of MEMS**
  - **Journal Bearing Stability**
- **Experimental Facility Tours** — **3:45-4:45**

Engine Seal Locations

Compressor discharge & Balance piston seal locations: Face & Brush seals

Turbine Rim & Interstage seal locations: Face & Brush seals

Blade Tip/Clearance Control



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